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In Re Application of:
Paul W. White
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For: **MOUNTING SYSTEM FOR SUBSEA FLOW INTERFACE EQUIPMENT**

TRANSMITTAL LETTER

Mail Stop Provisional Patent Application
Commissioner for Patents
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Alexandria, VA 22313-1450

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Enclosed herewith for filing in the above-identified case are:

- Provisional Application Cover Sheet;
- Provisional Application;
- Seven sheets of drawings;
- Our return postcard, which we would appreciate your date stamping and returning to us upon receipt.

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Respectfully submitted,

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PROVISIONAL APPLICATION COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION under 37 CFR 1.53(b)(2).

Docket No.	V2003043	Type a plus sign (+) inside this box ☐	+

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TITLE OF THE INVENTION (280 CHARACTERS MAX)

MOUNTING SYSTEM FOR SUBSEA FLOW INTERFACE EQUIPMENT

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ENCLOSED APPLICATION PARTS (check all that apply)

x Specification	14 pages
x Claims	26
x Abstract	
x Drawings	7 pages

METHOD OF PAYMENT (check one)

__ A check or money order is enclosed to cover the Provisional filing fees x The Commissioner is hereby authorized to charge or credit all filing fees or any additional fees to Deposit Account Number: 22-0279 ABB Vetco Gray	PROVISIONAL FILING FEE **$160.00**

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

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☐ Additional inventors are being named on separately numbered sheets attached hereto.

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V2003043

PROVISIONAL PATENT APPLICATION

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MOUNTING SYSTEM FOR SUBSEA FLOW INTERFACE EQUIPMENT

Field of the Invention:

This invention relates in general to subsea well production, and in particular to a mounting system for mounting flow interface equipment, such as a pump on a subsea Christmas tree assembly.

Background of the Invention:

A subsea production facility typically comprises a subsea Christmas tree with associated equipment. Some of the equipment mounted to the tree, such as a choke, requires retrieval from time-to-time for maintenance or replacement. Many subsea trees have guideposts that attach to guidelines for lowering choke retrieval tools into engagement with the frame of the tree. Also, the frame of the tree may have upward-facing guide members that provide alignment as the retrieval tool lands on the tree.

Other flow interface devices, such as multi-phase flow meters and pumps, have been proposed for releasable installation on a tree. Subsea pumps, as well as some flow meters, are quite heavy and bulky. Consequently, avoiding damage to the mating surfaces between the interface device and the flow line at the tree assembly while landing the interface device is a difficult task.

Summary of the Invention:

A mounting apparatus is provided for landing a flow interface device, particularly a subsea pump or compressor (referred to collectively at times as ":pressure intensifier") on a subsea production assembly. A mandrel with a flow passage is mounted to a lower frame. The operator lowers the lower frame into the sea and onto the production assembly. The production assembly has an upward facing receptacle that is sealingly engaged by the mandrel.

A manifold and a flow interface device such as a pressure intensifier are mounted to an upper frame. The operator lowers the upper frame along with the manifold and pressure intensifier into the sea and onto the lower frame, landing the manifold on the mandrel. During operation, fluid flows from the pressure intensifier through the manifold, the mandrel, and into the flow line.

Preferably, the subsea production assembly comprises a Christmas tree with a frame having guide posts. The operator installs extensions to the guide posts, if necessary, and attaches guidelines that extend to a surface platform. The lower and upper frames have sockets with passages for the guidelines. The engagement of the sockets with the guide posts provides gross alignment as the upper and lower frames are lowered onto the tree frame.

Also, preferably the Christmas tree frame has upward facing guide members that mate with downward facing guide members on the lower frame for providing finer alignment. Further, the lower frame preferably has upward facing guide members that mate with downward facing guide members on the upper frame for providing finer alignment. One or more locking members on the lower frame lock the lower frame to the tree frame. Additionally, one or more locking members on the upper frame lock the upper frame to the lower frame.

Stops or adjustable mechanisms may be incorporated with the locking members or separate. The adjustable stops select minimum distances between the lower frame and the upper plate of the tree frame and between the lower frame and the upper frame. The adjustable stops provide structural load paths from the upper frame through the lower frame and tree frame to the tree and the wellhead on which the tree is mounted. These load paths avoid structural loads passing to through the mandrel to the upward facing receptacle.

In another embodiment, the fluid interface device frame is lowered as a unit, but has an upper portion that is vertically movable relative to the lower portion. The pressure intensifier and mandrel are mounted to the upper portion. When the lower portion of the frame lands on the tree frame, the lower end of the mandrel will be spaced above the flow line receptacle. One or more jack mechanisms then lower the upper portion of the frame, causing the mandrel to stab sealingly into the receptacle.

Brief Description of the Drawings:

Figure 1 is an elevational view of a subsea tree assembly, partially in section, and showing a mounting apparatus for mounting a flow interface device in accordance with this invention.

Figure 2 is an enlarged view, partially in section, of a choke body of the tree assembly and a lower portion of a mandrel of the apparatus of Figure 1.

Figure 3 is a top view of the tree frame of Figure 1, with the mounting apparatus for the flow interface device removed.

Figure 4 is a top view of a lower frame of the mounting apparatus of Figure 1.

Figure 5 is a sectional view of the lower frame of Figure 4, taken along the line 5 - -5 of Figure 4.

Figure 6 is a top view of an upper frame of the mounting apparatus of Figure 1.

Figure 7 is a partially sectioned view of the upper frame of Figure 6, taken along the line 7 - - 7 of Figure 6.

Figure 8 is a schematic view of an alternate embodiment of a mounting system, shown prior to landing on the subsea tree assembly.

Figure 9 is a schematic view of the mounting system of Figure 8, with a lower frame of the mounting system landed on the subsea tree assembly and the upper frame in an upper position.

Figure 10 is a schematic view of the subsea tree assembly and the mounting system of Figure 8, with the upper frame in a lower position.

Detailed Description of the Invention:

Referring to Figure 1, production assembly 11 in this example includes a subsea Christmas tree 13. Christmas tree 13 is a tubular member with a tree connector 15 on its lower end that connects to a wellhead housing (not shown) located on the sea floor. Tree 13 may be conventional, having a vertical bore with a master valve 17 and a swab valve 19. A production passage in tree 13 leads laterally to a production wing valve 21. Tree 13 may be either a type having a tubing hanger landed within, or it may be a type in which the tubing hanger lands in the wellhead housing below the tree.

A production choke body or receptacle 23 mounts to production wing valve 21. Choke body 23 comprises a housing for a choke insert (not shown) that is adjustable to create a back pressure and a desired flow rate. Choke body 23 connects to a production flow line 25 that leads to sea floor processing equipment or directly to a production facility at sea level. After being installed with a pressure intensifier, as will be subsequently explained, a choke insert may not be required. One use for the mounting apparatus of this invention is to retrofit existing trees that have previously operated without a pressure intensifier.

Tree 13 may also have an annulus valve 27 that communicates with a tubing annulus passage (not shown) in the well. An annulus choke 29 connects to annulus valve 27 for controlling a flow rate either into or out of the tubing annulus. Annulus choke 29 is normally located on a side of production assembly 11 opposite production choke body 23. Annulus choke 29 has a body with a choke insert similar to production choke body 23.

A tree cap 31 releasably mounts to the upper end of tree 13. A tree frame 33 extends around tree 13 for mounting various associated equipment and providing protection to tree 13 in if snagged by fishing nets. Tree frame 33 is structurally connected to the body of tree 13, such

that weight imposed on tree frame 33 transfers to tree 13 and from there to the wellhead housing (not shown) on which tree 13 is mounted. Tree frame 33 has an upper frame portion or plate 35 that in this instance is located above swab valve 19 and below tree cap 31. Upper plate 35 surrounds tree 13, as shown in Figure 3, and is generally rectangular in configuration. Tree frame upper plate 35 has a cutout 36 that provides vertical access to choke body 23 and a cutout 38 that provides vertical access to annulus choke 29.

As shown in Figure 3, preferably tree frame upper plate 35 has a plurality of guide members 37. Guide members 37 may vary in type, and prior to retrofitting with a pressure intensifier, were used to land equipment for retrieving and replacing the choke insert (not shown) in choke body 23 and in annulus choke 29. Although some subsea trees do not have any type of guide members, many do, particularly trees installed during the past 10-15 years. In this example, each guide member 37 comprises an upward facing cylinder with an open top. Guide members 37 are mounted in pairs in this example with a locking member 39 located between them. Locking member 39 has a latch that latches onto a locking member inserted from above. Four separate sets of guide members 37 are shown in Figure 3, with one set located on opposite sides of cutout 36 and the other sets on opposite sides of cutout 38.

Figure 3 also shows a control pod receptacle 40 that may be conventional. Control pod receptacle 40 has guide members 37 and locking members 39 for landing an electrical and hydraulic control pod (not shown) lowered from sea level. A plurality of guide posts 41 are located adjacent sides of tree frame 33. Typically, each guide post 41 is located at a corner of tree frame 33, which is generally rectangular configuration. Only one guide post 41 is shown in Figure 1, but the other three are the same in appearance. The existing guide posts 41 likely may not be long enough for the retrofit of a pressure intensifier in accordance with this invention. If

so, a guide post extension 42 is installed over each guide post 41, and becomes a part of each guide post 41. Guide post extensions 42 protrude upward past tree cap 31. A guideline 43 with a socket on its lower end slides over and connects to each guide post 41 or guide post extension 42, if such are used. Guidelines 43 extend upward to a platform or workover vessel at sea level.

Still referring to Figure 1, a flow interface device lower frame 45 lands on and is supported by tree frame upper plate 35. In this embodiment, lower frame 45 is a flat generally rectangular member, as shown in Figure 4, but it need not be a flat plate. A mandrel 47 is secured to one side of lower frame 45. Mandrel 47 has a tubular lower portion with a flange 49 that abuts and seals to a mating flange on choke body 23. Alternately, mandrel 47 could be positioned on an opposite edge of lower frame 45 and mate with the body of annulus choke 29, rather than choke body 23.

A clamp 51 locks flange 49 to the flange of choke bode 23. Clamp 51 is preferably the same apparatus that previously clamped the choke insert (not shown) into choke body 23 when production assembly 11 was being operated without a pressure intensifier. Clamp 51 is preferably hydraulically actuated with hydraulic cylinders 50 (Figure 3). Typically, a mechanical actuator 54 enables an ROV (remote operated vehicle) to release and actuate clamp 51 in the event of a failure of hydraulic cylinders 50.

Referring to Figure 2, mandrel 47 has a lower bore 52 that aligns with choke body vertical bore 53. A retrievable plug 55 is shown installed within a lower portion of choke vertical bore 53. A lateral passage 57 leads from choke body vertical bore 53 above plug 55 to production wing valve 21 (Figure 1). Plug 55 prevents fluid flowing down through mandrel 47 from entering flow line 25. Some installations have a valve in flow line 25 downstream of choke body 23. If so, plug 55 is not required.

Referring to Figure 5, lower frame 45 has a plurality of guide members 67 on its lower side that mate with guide members 37 of tree frame upper plate 35 as shown in Figure 3. Only one of the sets of guide members 67 is shown, and they are shown in a schematic form. Furthermore, a locking member 69 protrudes downward from lower frame 45 for locking engagement with one of the locking members 39 (Figure 3) of tree frame upper plate 35. Lock member 69 is also shown schematically. Other types of locks are feasible.

Lower frame 45 also has guide post sockets 71, each preferably being a hollow tube with a downward facing funnel on its lower end. Guide post sockets 71 slide over guide lines 43 (Figure 1) and guide posts 41 or extensions 42. Guide posts 41 or their extensions 42 provide a gross alignment of mandrel 47 with choke body 23 (Figure 1). Guides 67 and 37 (Figure 1) provide finer alignment of mandrel 47 with choke body 23 (Figure 1).

Referring still to Figure 5, lower frame 45 also preferably has a plurality of upward facing guide member 75. In this example, guide members 75 are the same type as guide members 37 (Figure 3), being upward facing cylinders with open tops. Other types of guide members may be utilized as well. In this instance, preferably there are four sets of guide members 75, with each set comprising two guide members 75 with a locking member 77 located between as shown in Figure 4. Guide members 75 are located in vertical alignment with guide members 37 (Figure 3), but could be positioned elsewhere. Lower frame 45 also has a cutout 79 on one side for providing vertical access to annulus choke 29 (Figure 3).

An adjustment mechanism or mechanisms (not shown) may extend between lower frame 45 and tree frame upper plate 37 to assure that the weight on lower frame 45 transfers to tree frame upper plate 37 and not through mandrel 47 to choke body 23. While the lower end of mandrel 47 does abut the upper end of choke body 23, preferably, very little if any downward

load due to any weight on lower frame 45 passes down mandrel 47 to choke body 23. Applying a heavy load to choke body 23 could create excessive bending moments on the connection of production wing valve 21 to the body of tree 13. The adjustment mechanisms may comprise adjustable stops on the lower side of lower frame 45 that contact the upper side of tree frame upper plate 37 to provide a desired minimum distance between lower frame 45 and upper plate 37. The minimum distance would assure that the weight on lower frame 45 transfers to tree upper plate 35, and from there through tree frame 33 to tree 13 and the wellhead housing on which tree 13 is supported. The adjustment mechanisms could be separate from locking devices 69 or incorporated with them.

Referring to Figure 1, after lower frame 45 lands and locks to tree frame upper plate 35, an upper frame 81 is lowered, landed, and locked to lower frame 45. Upper frame 81 is also preferably a generally rectangular plate, but it could be configured in other shapes. Upper frame 81 has a mandrel connector 83 mounted on an upper side. Mandrel connector 83 slides over mandrel 47 while landing. A locking member 85, which could either be a set of dogs or a split ring, engages a grooved profile on the exterior of mandrel 47. Locking member 85 locks connector 83 to mandrel 47. A hydraulic actuator 87 strokes locking member 85 between the locked and released positions. Preferably, mandrel connector 83 also has a manual actuator 89 for access by an ROV in the event of failure of hydraulic actuator 87. A manifold 91 is a part of or mounted to an upper inner portion of mandrel connector 83. Manifold 91 has a passage 93 that sealingly registers with mandrel passage 63.

As shown by the dotted lines, a motor 95, preferably electrical, is mounted on upper frame 81. A filter 97 is located within an intake line 98 of a subsea pump 99. Motor 95 drives

pump 99, and the intake in this example is in communication with sea water. Pump 99 has an outlet line10 that leads to passage 93 of manifold 91.

As shown in Figure 6, upper frame 81 has four guide post sockets 103 for sliding down guidelines 43 (Figure 1) and onto the upper portions of guide posts 41 or guide post extensions 42. Upper frame 81 has downward extending guide members 105 that mate with upward extending guide members 75 of lower frame 45, as shown in Figure 7. Locking members 107 mate with locking members 77 (Figure 4) of lower frame 45. Upper frame 81 has a central hole 109 for access to tree cap 31 (Figure 1).

Adjustable mechanisms or stops (not shown) may also extend between lower frame 45 and upper frame 81 to provide a minimum distance between them when landed. The minimum distance is selected to prevent the weight of pump 99 and motor 95 from transmitting through mandrel connector 83 to mandrel 47 and choke body 23. Rather, the load path for the weight is from upper frame 81 through lower frame 45 and tree frame upper plate35 to tree 13 and the wellhead housing on which it is supported. The load path for the weight on upper frame 81 does not pass to choke body 23 or through guide posts 41. The adjustable stops could be separate from locking devices 107 or incorporated with them.

In the operation of this example, production assembly 11 may have been operating for some time either as a producing well, or an injection well with fluid delivered from a pump at a sea level platform. Also, production assembly 11 could be a new installation. Lower frame 45, upper frame 81 and the associated equipment would originally not be located on production assembly 11. If production assembly 11 were formerly a producing well, a choke insert (not shown) would have been installed within choke body 23.

To install pressure intensifier 99, the operator would attach guide post extensions 42, if necessary, and extend guidelines 43 to the surface vessel or platform. The operator removes the choke insert in a conventional manner by a choke retrieval tool (not shown) that interfaces with the two sets of guide members 37 adjacent cutout 36 (Fig. 3). If production assembly 11 lacks a valve on flow line 25, the operator lowers a plug installation tool on guidelines 43 and installs a plug 55.

The operator then lowers lower frame 45 along guidelines 43 and over guide posts 41. While landing, guide members 67 and lock members 69 (Figure 5) slidingly engage upward facing guide members 37 and locking members 39 (Figure 1). The engagement of guide members 37 and 67 provides fine alignment for mandrel 47 as it engages choke body 23. Then, clamp 51 is actuated to connect the lower end of mandrel 47 to choke body 23.

The operator then lowers upper frame 81, including pump 99, which has been installed at the surface on upper frame 81. Upper frame 81 slides down guidelines 43 and over guide posts 41 or their extensions 42. After manifold 91 engages mandrel 47, connector 83 is actuated to lock manifold 91 to mandrel 47. Electrical power for pump motor 95 may be provided by an electrical wet-mate connector (not shown) that engages a portion of the control pod (not shown), or in some other manner. If the control pod did not have such a wet mate connector, it could be retrieved to the surface and provided with one.

Once installed, with valves 17 and 21 open, sea water is pumped by pump 99 through outlet line 101, and flow passages 93, 52 (Figure 2) into production wing valve 21. The sea water flows down the well and into the formation for water flood purposes. If repair or replacement of pressure intensifier 99 is required, it can be retrieved along with upper frame 81 without disturbing lower frame 45.

An alternate embodiment is shown in Figures 8-10. Components that are the same as in the first embodiment are numbered the same. The mounting system has a lower frame or frame portion 111 and an upper frame or frame portion 113. Jack mechanisms, such as hydraulic cylinders 115, extend between lower and upper frames 111, 113. Hydraulic cylinders 115 move upper frame 113 relative to lower frame 111 from an upper position, shown in Figures 8 and 9, to a lower position, shown in Figure 10. Lower frame 111 preferably has guide members on its lower side for engaging upward facing guides on tree frame upper plate 35, although they are not shown in the drawings.

Mandrel 117 is rigidly mounted to upper frame 113 in this embodiment and has a manifold portion on its upper end that connects to outlet line 101, which in turn leads from pressure intensifier or pump 99. Mandrel 117 is positioned over or within a hole 118 in lower frame 111. When upper frame 113 moves to the lower position, shown in Figure 10, mandrel 117 extends down into engagement with the receptacle of choke body 23.

In the operation of the second embodiment, pressure intensifier 99 is mounted to upper frame 113, and upper and lower frames 113, 111 are lowered as a unit. Hydraulic cylinders 115 will support upper frame 113 in the upper position. Guidelines 43 and guide posts 41 guide the assembly onto tree frame upper plate 35, as shown in Figure 9. Guide members (not shown) provide fine alignment of lower frame 111 as it lands on tree frame upper plate 35. The lower end of mandrel 117 will be spaced above choke body 23. Then hydraulic cylinders 115 allow upper frame 113 to move downward slowly. Mandrel 117 engages choke body 23, and clamp 51 is actuated to clamp mandrel 117 to choke body 23. Locks (not shown) lock lower and upper frames 111, 113 to the tree frame of tree 13.

This invention has significant advantages. The lower frame and mandrel are much lighter in weight and less bulky than the upper frame and pump assembly. Consequently, it is easier to guide the mandrel into engagement with the choke body than it would be if the entire assembly were joined together and lowered as one unit. Once the lower frame is installed, the upper frame and pump assembly can be lowered with a lesser chance of damage to the subsea equipment. The upper end of the mandrel is rugged and strong enough to withstand accidental impact by the upper frame. The two-step process thus makes installation much easier. The optional guide members further provide fine alignment to avoid damage to seating surfaces. The movable upper and lower frames of the mounting system of the alternate embodiment avoid damage to the seating surfaces of the mandrel and the receptacle.

While the invention has been shown in only two of its forms, it should be apparent to those skilled in the art that it is not so limited but is susceptible to various changes without departing from the scope of the invention. For example, although shown in connection with a subsea tree assembly, the mounting apparatus could be installed on other subsea structures, such as a manifold or gathering assembly. Also, the flow interface device mounted to the upper frame could be a compressor for compressing gas, a flow meter for measuring the flow rate of the subsea well, or some other device.

CLAIMS:

1. In a subsea production assembly having a flow line containing an upward facing receptacle, the improvement comprising:

a lower frame that is lowered into the sea and landed on the production assembly;

a mandrel mounted to the lower frame, the mandrel having a lower end that lands on and connects to the receptacle, the mandrel having a flow passage for fluid communication with the receptacle;

an upper frame that is lowered into the sea and landed on the lower frame;

a flow interface device mounted on the upper frame;

a manifold carried by and lowered with the upper frame, the manifold having a lower end that lands on and connects to an upper end of the mandrel, the manifold having a flow passage that registers with the flow passage in the mandrel; and

the flow interface device being in fluid communication with the flow passage of the manifold.

2. The production assembly according to claim 1, further comprising:

a plurality of guide posts on the production assembly for connecting to guide lines;

a plurality of guide sockets on the lower frame that slide down the guide lines and land on the guide posts; and

a plurality of guide sockets on the upper frame that slide down the guide lines and land on the guide posts.

3. The production assembly according to claim 1, further comprising:

a plurality of guide members on the production assembly;

a plurality of guide members on the lower frame that engage the guide members on the production assembly as the lower frame lands on the production assembly to align the mandrel with the receptacle.

4.The production assembly according to claim 1, further comprising:

a plurality of guide members on the lower frame; and

a plurality of guide members on the upper frame that engage the guide members on the lower frame to align the manifold with the mandrel as the upper frame lands on the lower frame.

5. The production assembly according to claim 1, further comprising:

a plurality of guide posts on the production assembly for connecting to guide lines;

a plurality of guide sockets on the lower frame that slide down the guide lines and land on the guide posts to provide coarse alignment of the mandrel with the receptacle as the lower frame lands on the production assembly; and

a plurality of mating guide members on the production assembly and the lower frame that slidingly engage each other for providing a finer alignment of the mandrel with the receptacle as the lower frame lands on the production assembly.

6. The production assembly according to claim 1, further comprising:

a plurality of guide posts on the production assembly for connecting to guide lines;

a plurality of guide sockets on the upper frame that slide down the guide lines and land on the guide posts to provide coarse alignment of the manifold with the mandrel as the upper frame lands on the lower frame; and

a plurality of mating guide members on the lower frame and the upper frame that slidingly engage each other for providing a finer alignment of the mandrel with the receptacle as the lower frame lands on the production assembly.

7. The production assembly according to claim 1, further comprising:

a lower locking member on the lower frame that locks the lower frame to the production assembly.

8. The production assembly according to claim 1, further comprising:

an upper locking member on the upper frame that locks the upper frame to the lower frame.

9. The production assembly according to claim 1, wherein the flow interface device comprises a pump having an inlet for drawing sea water and a motor for driving the pump.

10. In a subsea production assembly having a Christmas tree mounted on a wellhead, a choke body connected to and on one side of the tree, a flow line extending from the choke body, and a tree frame structurally connected to the Christmas tree, the improvement comprising:

a lower frame that lands on the tree frame;

a mandrel mounted to the lower frame, the mandrel having a tubular lower end that lands on and connects to the choke body, the mandrel having a flow passage that registers with an interior of the choke body;

an upper frame for supporting a pressure intensifier;

a manifold carried by and lowered with the upper frame, the manifold having a lower end that lands on and connects to an upper end of the mandrel, the manifold having a flow passage that registers with the flow passage in the mandrel for communicating the pressure intensifier with the manifold;

at least one stop member located between the tree frame and the lower frame, and at least one stop member located between the upper and lower frames, for transferring substantially the entire weight of the pressure intensifier from the upper frame, and through the lower frame and tree frame to the tree and the wellhead.

11. The production assembly according to claim 10 wherein the stop members are adjustable in height.

12. In a subsea production assembly having a Christmas tree, a choke body connected to and on one side of the tree, a flow line extending from the choke body, and a set of guide posts for connection to guidelines, the improvement comprising:

a lower frame that lands on the production assembly, the lower frame having a set of guide sockets for sliding down the guidelines and engaging the guide posts;

a mandrel mounted to the lower frame, the mandrel having a tubular lower end that lands on and connects to the choke body, the mandrel having a flow passage that registers with an interior of the choke body;

an upper frame for supporting a pressure intensifier, the upper frame having a set of guide sockets for sliding down the guidelines and engaging the guide posts above the guide sockets of the lower frame; and

a manifold carried by and lowered with the upper frame, the manifold having a lower end that lands on and connects to an upper end of the mandrel, the manifold having a flow passage that registers with the flow passage in the mandrel for communicating the pressure intensifier with the manifold.

13. The production assembly according to claim 12, further comprising:

a hydraulically actuated locking member on the production assembly for locking the mandrel to the choke body.

14. The production assembly according to claim 12, further comprising:

a hydraulically actuated locking member on the manifold that locks the manifold to the mandrel.

15. The production assembly according to claim 12, further comprising:

mating guide members on a lower side of the lower frame and an upper side of the production assembly for providing fine alignment of the mandrel with the choke body as the lower frame lands on the production assembly.

16. The production assembly according to claim 12, further comprising:

mating guide members on a lower side of the upper frame and an upper side of the lower frame for providing fine alignment of the manifold with the mandrel as the upper frame lands on the lower frame.

17. The production assembly according to claim 12, further comprising:

a lower locking member on the lower frame that locks the lower frame to the production assembly.

18. The production assembly according to claim 12, further comprising:

an upper locking member on the upper frame that locks the upper frame to the lower frame.

19. A method of flowing fluid into a flow line of a subsea production assembly, the flow line containing an upward facing receptacle, comprising:

(a) mounting a mandrel with a flow passage to a lower frame;

(b) lowering the lower frame into the sea and onto the production assembly and landing a lower portion of the mandrel on the receptacle;

(c) mounting a pressure intensifier and a manifold to an upper frame; then

(d) lowering the upper frame and the pressure intensifier into the sea and onto the lower frame, and landing a lower portion of the manifold on the mandrel; then

(e) operating the pressure intensifier to deliver fluid through the receptacle into the flow line.

20. The method according to claim 19, wherein the fluid of step (e) comprises sea water that is drawn into an intake of the pressure intensifier.

21. The method according to claim 19, wherein step (b) comprises lowering the lower frame on guidelines that extend to guide posts of the production assembly.

22. The method according to claim 19, wherein step (d) comprises lowering the upper frame on guidelines that extend to guide posts of the production assembly.

23. The method according to claim 19, wherein step (b) comprises locking the lower frame to the production assembly.

24. The method according to claim 19, wherein step (d) comprises locking the upper frame to the production assembly.

25. An apparatus for flowing fluid into a flow line of a subsea production assembly, the flow line containing an upward facing receptacle, comprising:

a pressure intensifier mounted to an upper portion of the frame;

a mandrel having a flow passage and being mounted to an upper portion of the frame in fluid communication with the mandrel; and

a jack mechanism connected between the upper portion of the frame and a lower portion of the frame for moving the upper portion of the frame from an upper position downward relative

to the lower portion of the frame, the mandrel having a lower portion spaced above the receptacle while the upper portion of the frame is in the upper position after the lower portion of the frame has landed on the production assembly, the jack mechanism subsequently lowering the upper portion of the frame to the lower position wherein the lower portion of the mandrel engages the receptacle.

26. A method of flowing fluid into a flow line of a subsea production assembly, the flow line containing an upward facing receptacle, comprising:

(a) mounting a pressure intensifier and a mandrel with a flow passage to an upper portion of a frame, the pressure intensifier being in fluid communication with the mandrel, the upper portion of the frame being vertically movable relative to a lower portion of the frame; then

(b) lowering the frame into the sea and onto the production assembly and landing the lower portion of the frame on the production assembly with the mandrel spaced above the receptacle; then

(c) lowering the upper portion of the frame and stabbing the mandrel into sealing engagement with the receptacle; then

(d) operating the pressure intensifier to deliver fluid through the receptacle into the flow line.

Abstract of the Disclosure:

A mounting system for a pressure intensifier for a subsea production assembly utilizes a two-step process. First, a lower frame with a mandrel is lowered onto the subsea production assembly, with the mandrel stabbing into an upward facing receptacle. Then, an upper frame and a pressure intensifier and manifold are lowered onto the lower frame. The manifold sealingly engages the upper end of the mandrel, the manifold being connected to the pressure intensifier. Guidelines attached to guide posts provide gross alignment for the lower and upper frames. Mating guide members on the upper and lower frames and the production assembly provide fine alignment.

V2003043
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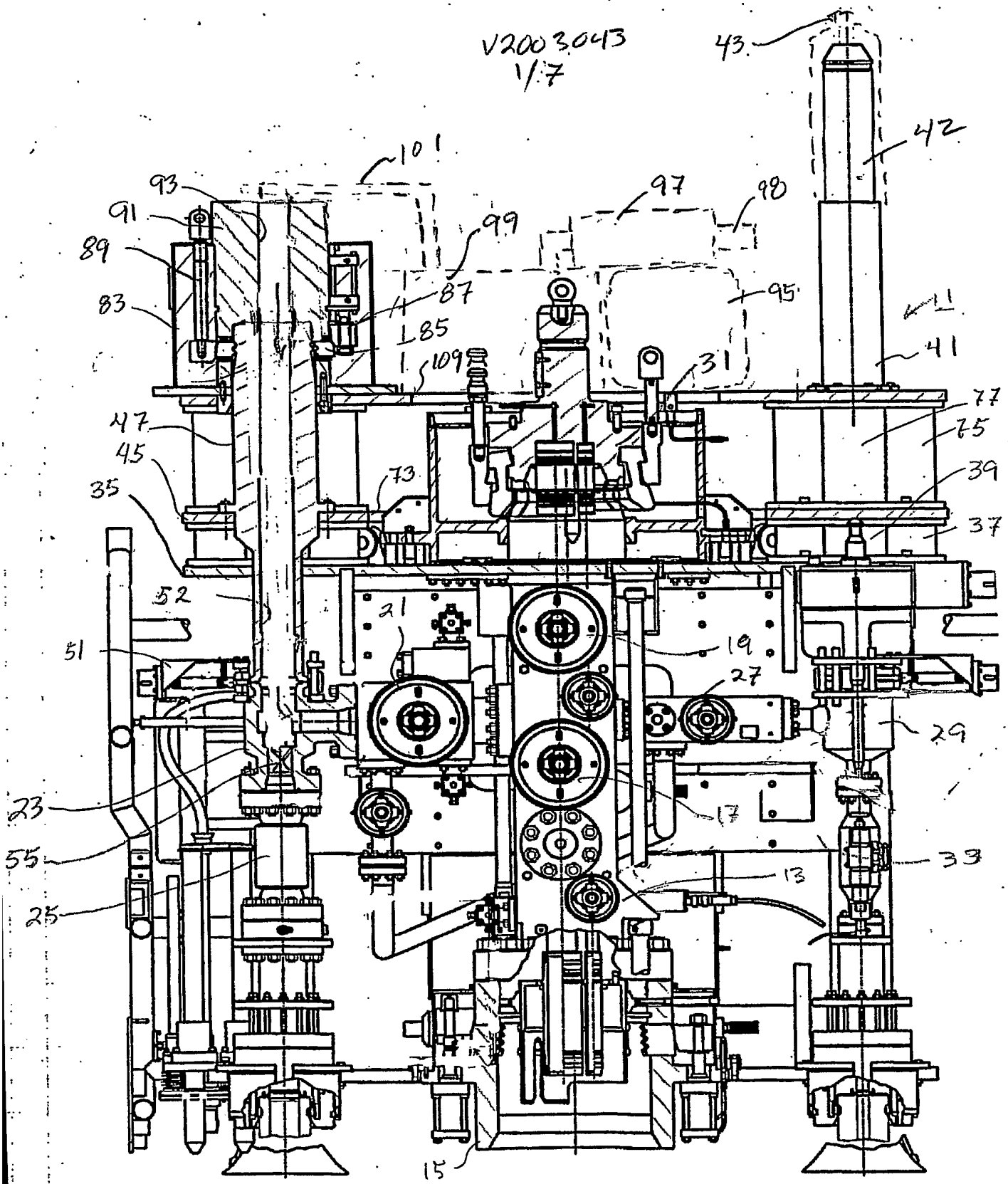

FIG. 1

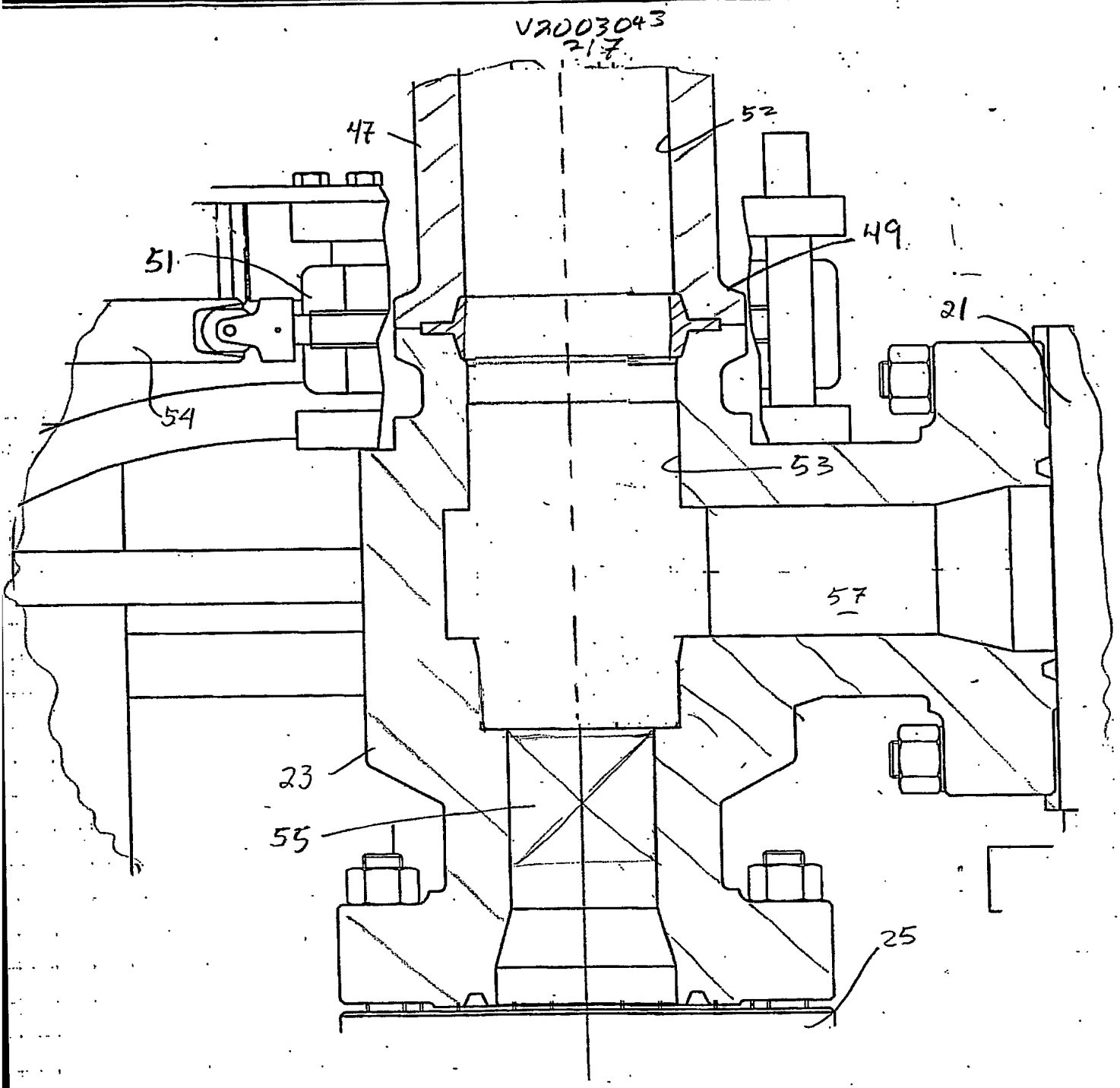

FIG 2

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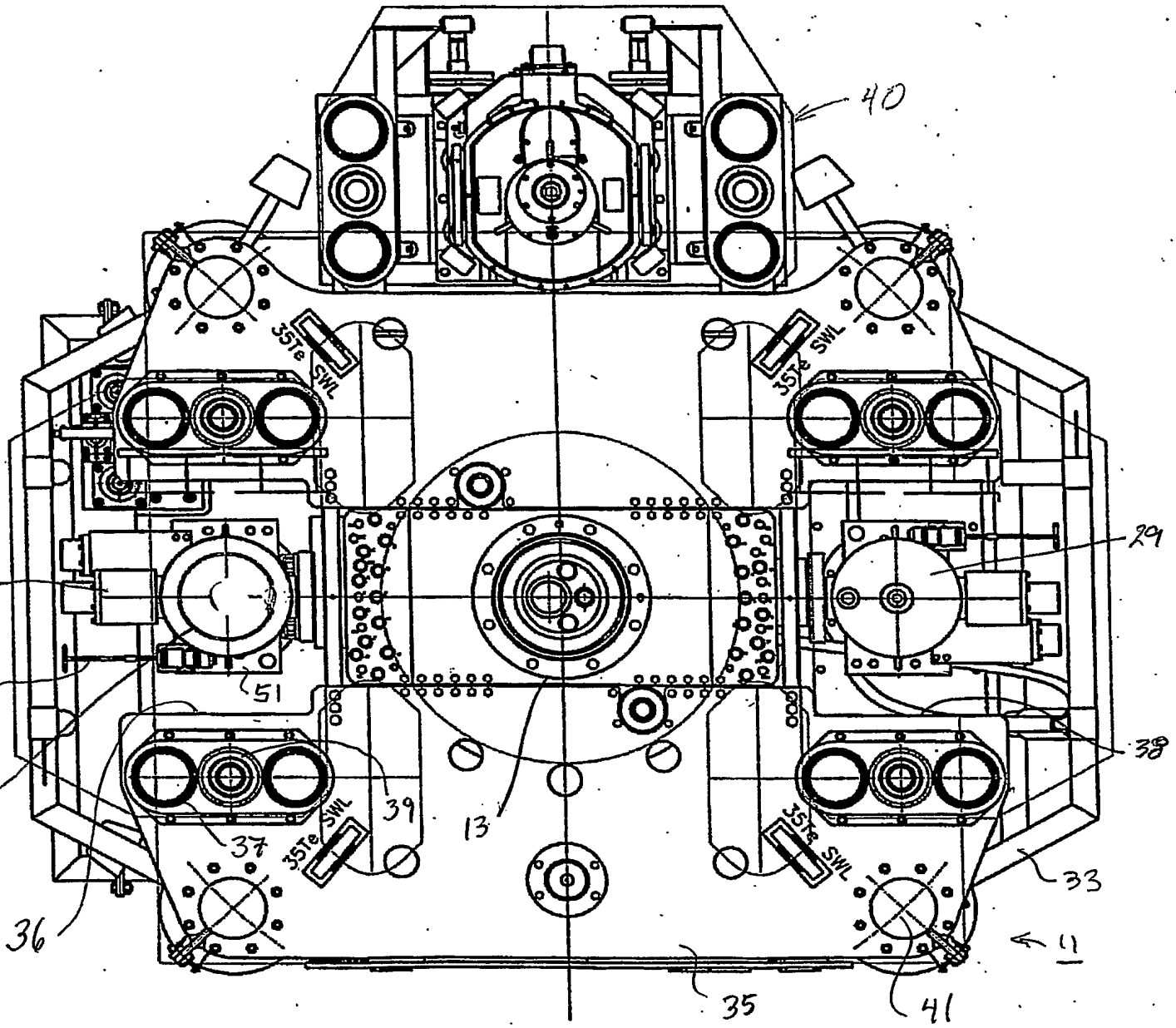

FIG. 3.

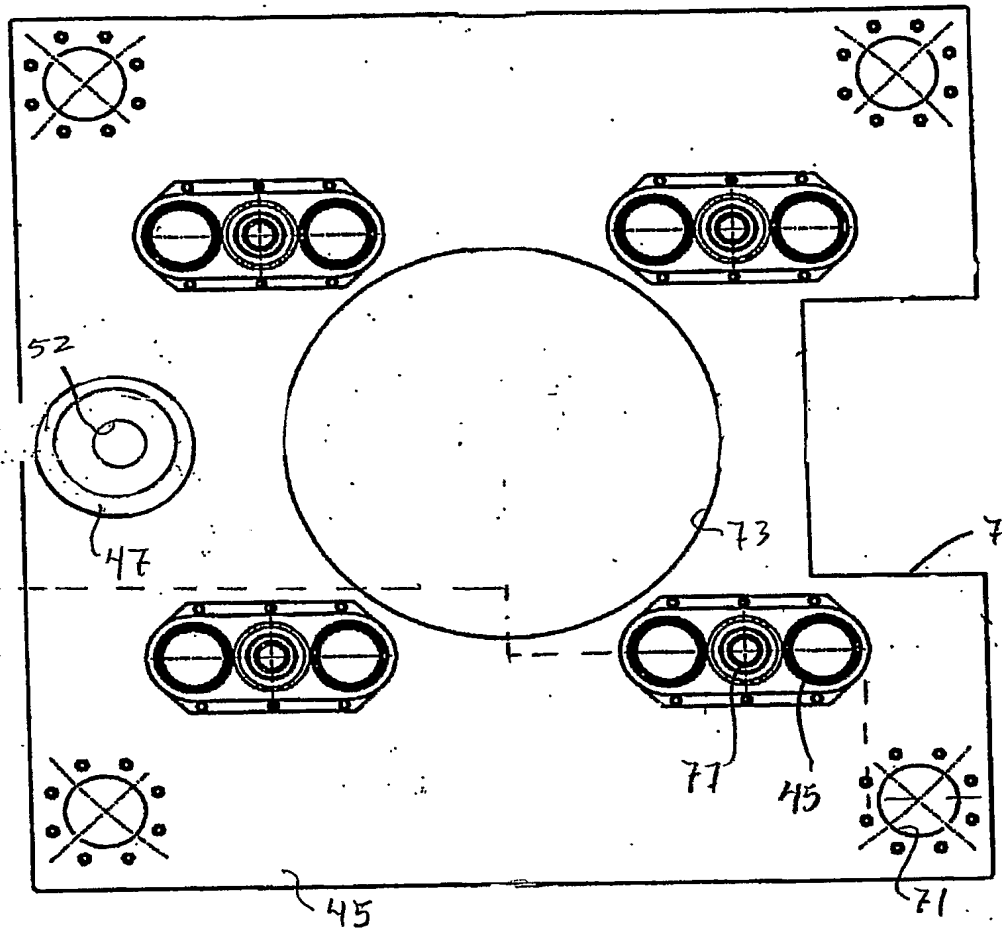

FIG. 4

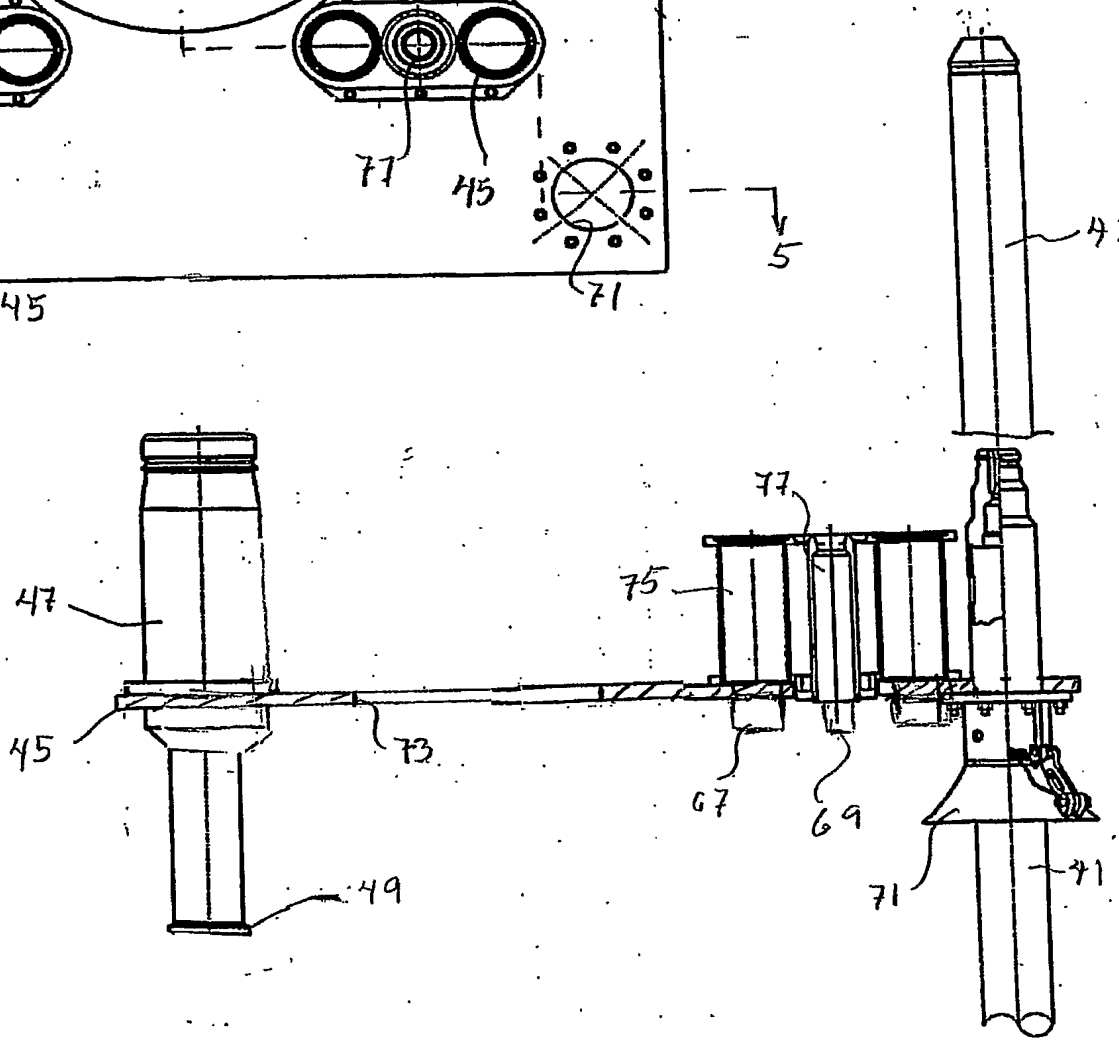

FIG. 5

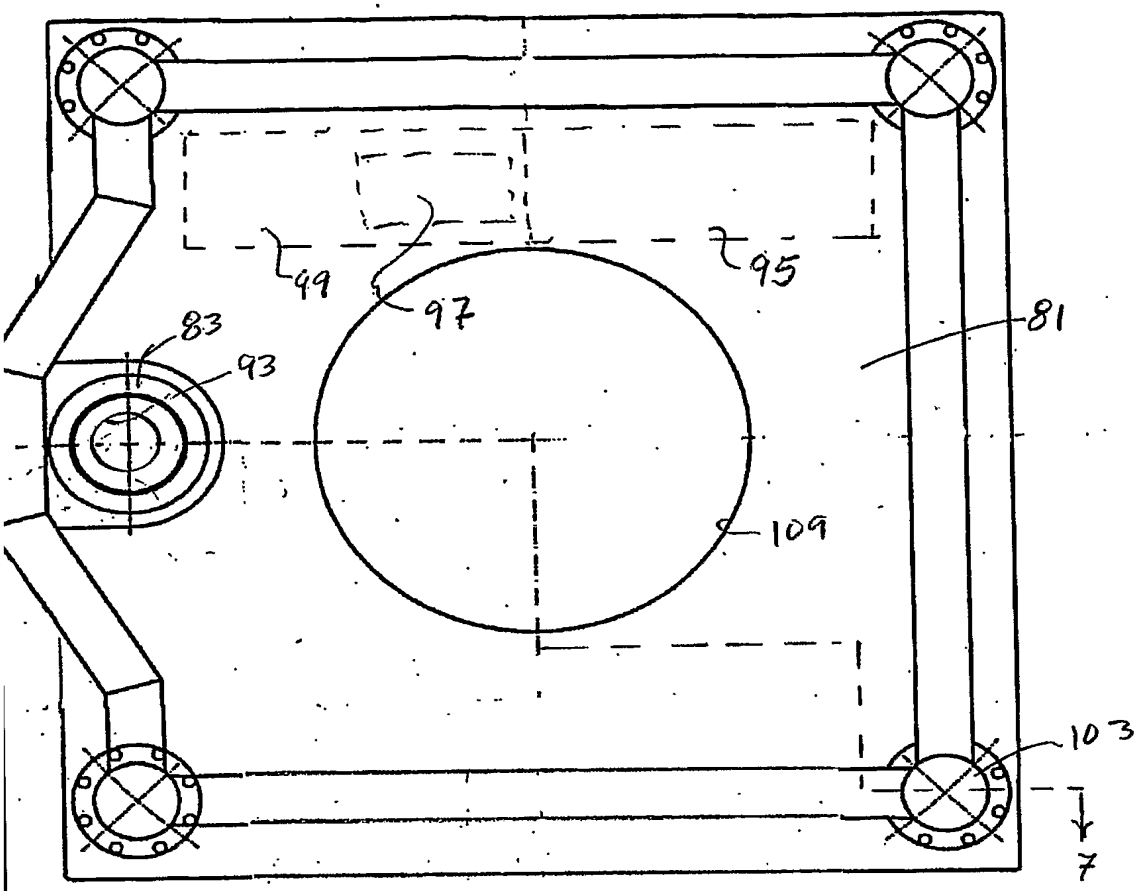

FIG. 6

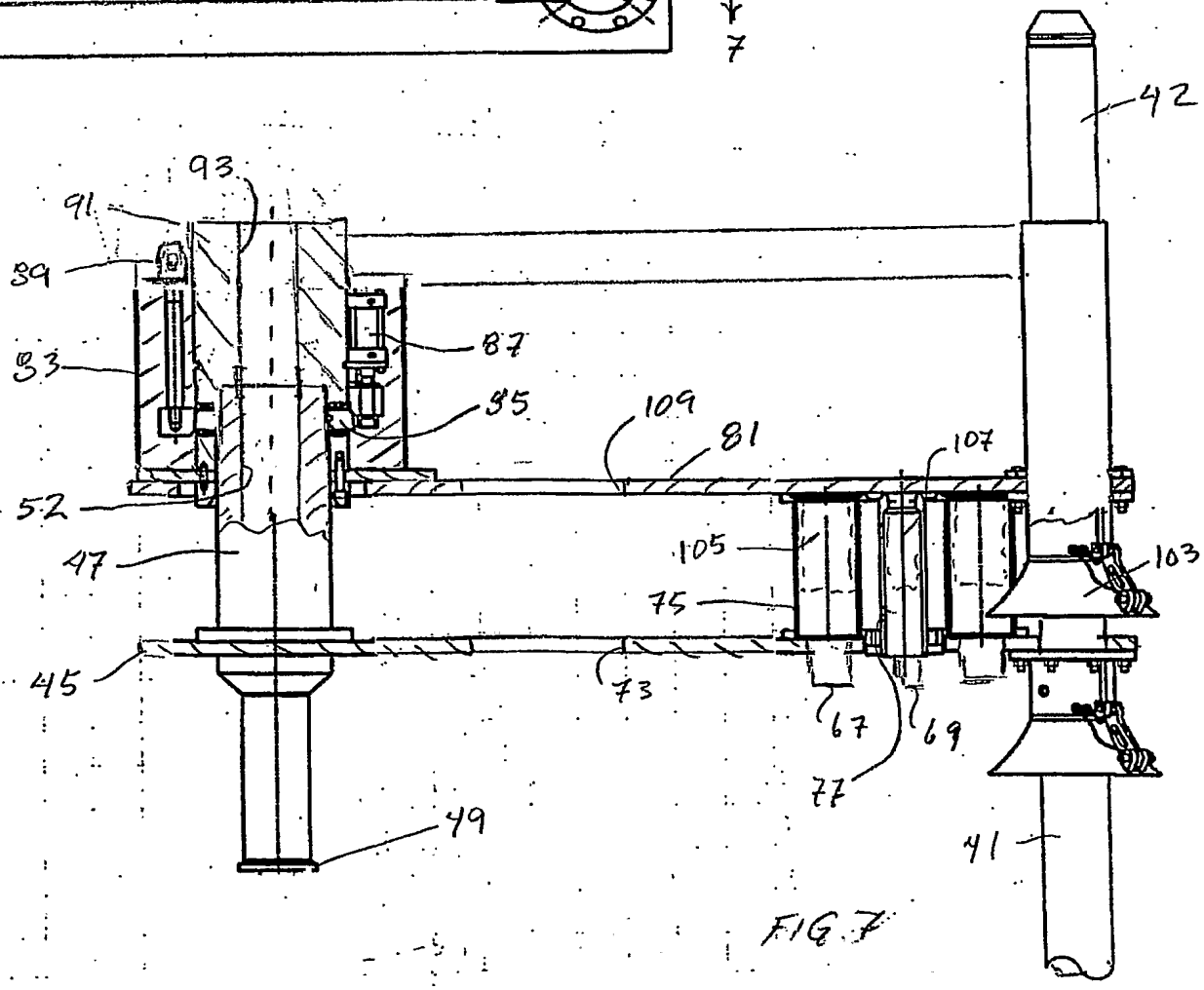

FIG. 7

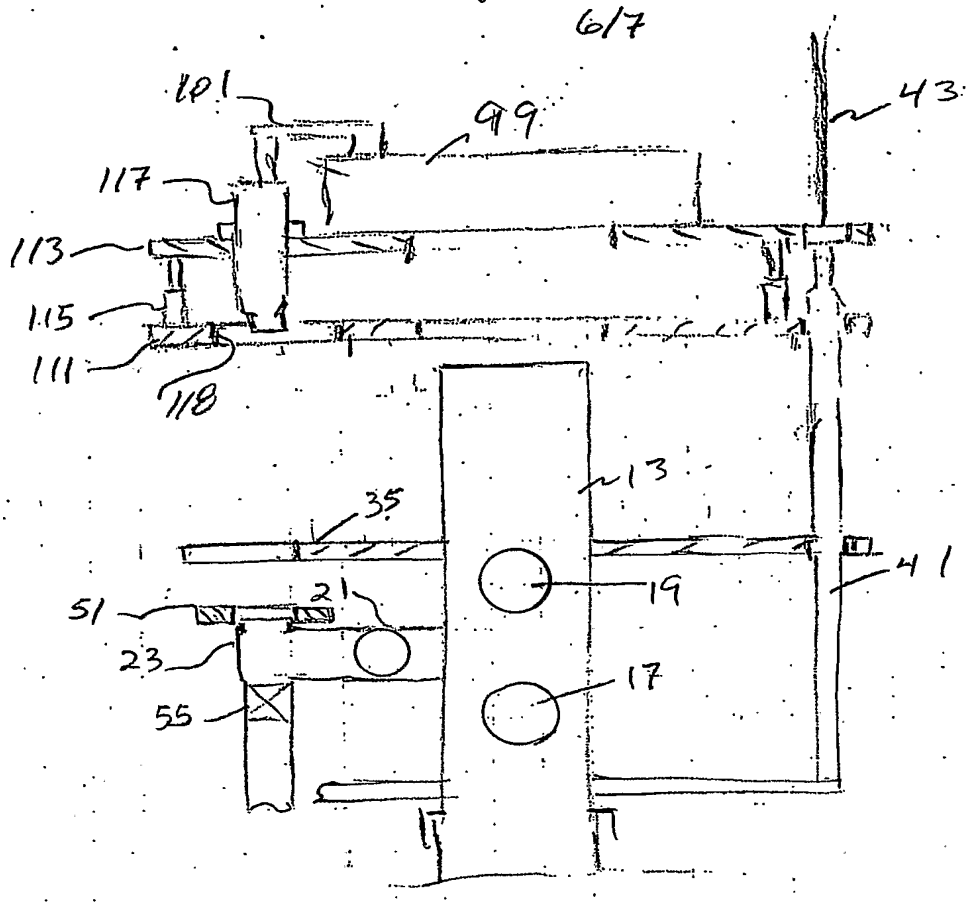

FIG. 8

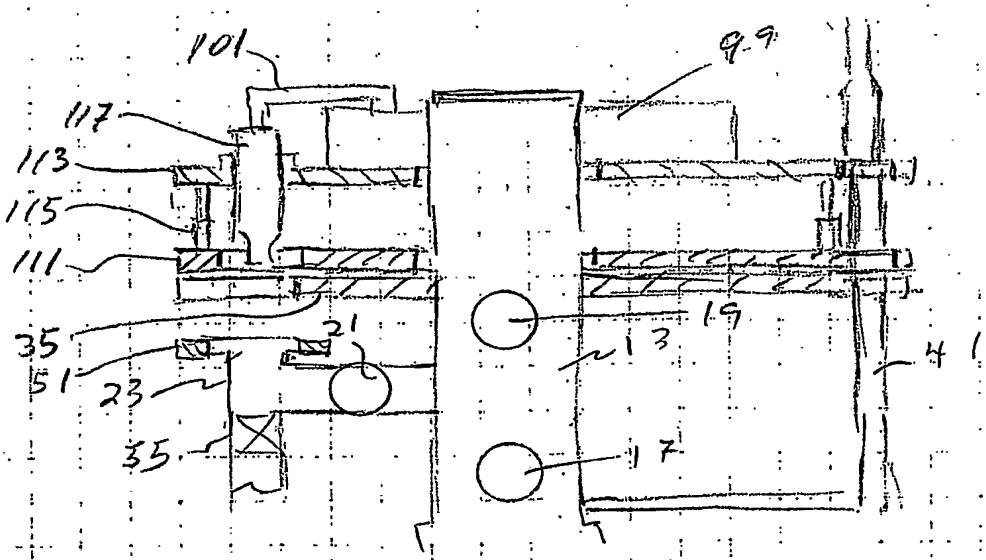

FIG 9

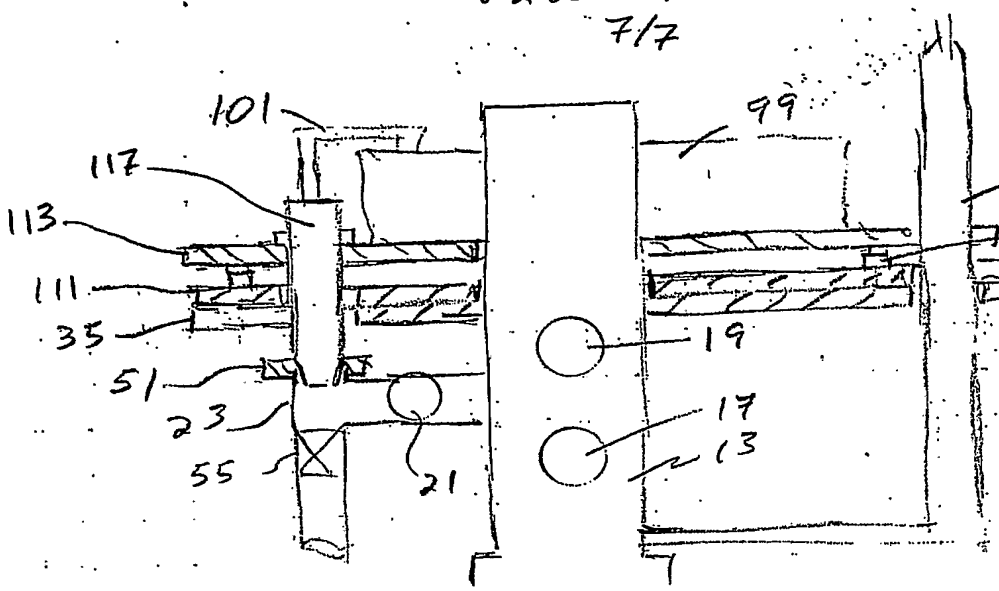

FIG 10